CLAIMS:

1. A method for performing equalization on an input signal in a receiver comprising:
creating a plurality of delayed samples of the input signal;
orthogonally transforming each of the plurality of delayed input samples;
weighting the plurality of orthogonally-transformed delayed input samples using a first corresponding plurality of transformed adaptive coefficients; and
summing the weighted plurality of orthogonally-transformed delayed input samples along with a feedback signal and outputting a result of the summing as an equalizer output signal.

2. The method according to claim 1, wherein the feedback signal is formed by:
creating a plurality of delayed samples of a receiver decision signal ;
orthogonally transforming each of the plurality of delayed decision samples;
weighting the plurality of orthogonally-transformed delayed decision samples using a second corresponding plurality of transformed adaptive coefficients; and
summing the weighted plurality of orthogonally-transformed delayed decision samples to create the feedback signal.

3. The method according to claim 1, wherein the feedback signal is formed by:
creating a plurality of delayed samples of a receiver decision signal;
weighting the plurality of delayed decision samples using a plurality of adaptive coefficients; and
summing the weighted plurality of delayed decision samples to create the feedback signal.

4. The method according to claim 1, wherein the orthogonal transform comprises a Fast Fourier Transform.

5. The method according to claim 1, wherein the orthogonal transform comprises a Discrete Cosine Transform.

6. The method according to claim 1, further comprising coupling the equalizer output signal to a decision device and receiving a receiver decision signal back from the decision device.

7. The method according to claim 3, further comprising updating the plurality of adaptive coefficients.

8. The method according to claim 7, wherein the step of updating the plurality of adaptive coefficients (f(n)) includes calculating:

$$\mathbf{f}(n+1) = \mathbf{f}(n) + \mu e(n)\mathbf{b}(n-1)^*$$

in which

μ is an adaptation step size in a time-domain;

e(n) =b(n) – y(n);

b(n) is the receiver decision signal and "*" denotes a complex conjugate; and

y(n) is the equalizer output signal.

9. The method according to claim 2, further comprising updating the second corresponding plurality of transformed adaptive coefficients.

10. The method according to claim 9, wherein the step of updating the second corresponding plurality of transformed adaptive coefficients (ν(n)) includes calculating:

$$\nu(n) = \mathbf{f}(n)\mathbf{T}_2^{-1T}$$

$$\nu(n+1) = \nu(n) + \mu_2 e(n)\beta^*(n)$$

$$\beta(n) = \mathbf{b}(n)\mathbf{T}_2$$

in which

μ_2 is an adaptation step size in a transform-domain;

e(n) =b(n) – y(n);

b(n) is the receiver decision signal;

"*" denotes a complex conjugate;

"T" denotes a transpose operation;

y(n) is the equalizer output signal;

T_2 is an NxN orthogonal transform matrix; and

f(n) are feedback filter coefficients.

11. The method according to claim 10, wherein the adaptation step size in the transform domain is calculated as follows:

$$\mu_2 = pN\mu$$

in which

p is an average power of the input signal in a time-domain; and

μ is an adaptation step size in the time-domain.

12. The method according to claim 9, wherein the step of updating the second corresponding plurality of transformed adaptive coefficients (ν(n)) includes calculating:

$$\nu(n) = \mathbf{f}(n)\mathbf{T}_2^{-1T}$$

$$\nu(n+1) = \nu(n) + \mu_2 e(n)\boldsymbol{\beta}^*(n) \cdot / \boldsymbol{\Gamma}_b(n)$$

$$\boldsymbol{\beta}(n) = \mathbf{b}(n)\mathbf{T}_2$$

$$\boldsymbol{\Gamma}_b(n+1) = \lambda\boldsymbol{\Gamma}_b(n) + |\boldsymbol{\beta}(n)|^2$$

in which

Γ_b (n) is a vector containing the average value of the transform of b(n)

λ is a positive time constant

μ_2 is an adaptation step size in a transform-domain;

e(n) =b(n) – y(n);

b(n) is the receiver decision signal;

"*" denotes a complex conjugate;

"T" denotes a transpose operation;

"•/" denotes an element-wise vector division;

"$|\ |^2$" denotes an element-wise magnitude operation;

y(n) is the equalizer output signal;

T_2 is an NxN orthogonal transform matrix; and

f(n) are feed-back filter coefficients.

13. The method according to claim 12, wherein the adaptation step size in the transform domain is calculated as follows:

$$\mu_2 = pN\mu$$

in which

p is an average power of the input signal in a time-domain; and

μ is an adaptation step size in the time-domain.

14. The method according to claim 1, further comprising updating the first corresponding plurality of transformed adaptive coefficients.

15. The method according to claim 14, wherein the step of updating the first corresponding plurality of transformed adaptive coefficients ($\zeta(n)$) includes calculating:

$$\zeta(n) = \mathbf{c}(n)\mathbf{T}_1^{-1T}$$

$$\zeta(n+1) = \zeta(n) + \mu_1 e(n)\chi^*(n)$$

$$\chi(n) = \mathbf{x}(n) \cdot \mathbf{T}_1$$

in which

μ_1 is an adaptation step size in a transform-domain;

e(n) =b(n) – y(n);

b(n) is the receiver decision signal;

"*" denotes a complex conjugate;

"T" denotes a transpose operation;

y(n) is the equalizer output signal;

x(n) is the input signal;

T_1 is an MxM orthogonal transform matrix; and

c(n) are feed-forward filter coefficients.

16. The method according to claim 15, wherein the adaptation step size in the transform domain is calculated as follows:

$$\mu_1 = pM\mu$$

in which

p is an average power of the input signal in a time-domain; and

μ is an adaptation step size in the time-domain.

17. The method according to claim 14, wherein the step of updating the first corresponding plurality of transformed adaptive coefficients ($\varsigma(n)$) includes calculating:

$$\varsigma(n) = \mathbf{c}(n)\mathbf{T}_1^{-1T}$$

$$\varsigma(n+1) = \varsigma(n) + \mu_1 e(n)\chi^*(n) \cdot / \boldsymbol{\Gamma}_x(n)$$

$$\chi(n) = \mathbf{x}(n) \cdot \mathbf{T}_1$$

$$\boldsymbol{\Gamma}_x(n+1) = \lambda\boldsymbol{\Gamma}_x(n) + |\chi(n)|^2$$

in which

Γ_x (n) is a vector containing the average vaules of the transform of x(n)

λ is a positive time constant

μ is an adaptation step size in a time-domain;

e(n) =b(n) – y(n);

b(n) is the receiver decision signal;

"*" denotes a complex conjugate;

"T" denotes a transpose operation;

"•/" denotes an element-wise vector division;

"$|\ |^2$" denotes an element-wise magnitude operation;

y(n) is the equalizer output signal;

x(n) is the input signal;

T_1 is an NxN orthogonal transform matrix; and

c(n) are feed-forward filter coefficients.

18. The method according to claim 17, wherein the adaptation step size in the transform domain is calculated as follows:

$$\mu_1 = pM\mu$$

in which

p is an average power of the input signal in a time-domain; and

μ is an adaptation step size in the time-domain.

19. The method according to claim 1, wherein said orthogonally transforming comprises computing a transform of each of the plurality of delayed input samples in a recursive manner by using a prior orthogonal transform of a prior one of the plurality of delayed input samples in a next orthogonal transform of a next one of the plurality of delayed input samples.

20. The method according to claim 19, wherein said computing the transform comprises calculating each (X(k,n)) of the plurality of orthogonally-transformed delayed input samples by:

calculating a difference between one of the delayed input samples (x(n)) and an Mth delayed version of said one of the delayed input samples (x(n-M));

adding a kth feedback signal to the difference;

multiplying a sum from the adding by a kth coefficient;

outputting the multiplied sum as said each (X(k,n)) of the plurality of orthogonally-transformed delaying input samples;

delaying the multiplied sum;

feeding back the delayed multiplied sum as the kth feedback signal.

21. A method for performing equalization in a receiver comprising:

orthogonally transforming each of a plurality of delayed input samples;

weighting the plurality of orthogonally-transformed delayed input samples using a first corresponding plurality of transformed adaptive coefficients;

summing the weighted plurality of orthogonally-transformed delayed input samples along with a feedback signal and outputting a result of the summing as an equalizer output signal; and

modifying the first corresponding plurality of transformed adaptive coefficients based on decisions made in the receiver using prior versions of an equalizer output signal.

22. A method for receiving a digital signal comprising:

creating a plurality of delayed versions of the digital signal;

orthogonally transforming each of the plurality of delayed versions of the digital signal and weighting them using a plurality of transformed adaptive coefficients;

summing the weighted plurality of orthogonally-transformed delayed versions of the digital signal along with a feedback signal to create an equalized output signal; and

adaptively updating the plurality of transformed adaptive coefficients based on decisions made in the receiver using prior versions of an equalized output signal.

23. An apparatus 10 for receiving a digital signal comprising:

a receiver decision device; and

an adaptive equalizer coupled to the receiver decision device, said equalizer including a processor to:

create a plurality of delayed versions of the digital signal;

orthogonally transform each of the plurality of delayed versions of the digital signal and weight them using a plurality of transformed adaptive coefficients;

sum the weighted plurality of orthogonally-transformed delayed versions of the digital signal along with a feedback signal to create an equalized output signal; and

adaptively update the plurality of transformed adaptive coefficients based on decisions made in the receiver decision device using prior versions of an equalized output signal.